

Hovercraft

1. **DESCRIPTION:** Competitors may construct up to two self-propelled air-levitated vehicles each with up to two battery-powered motors that turns one propeller each to levitate and move the vehicle(s) down a track. Competitors must also be tested on their knowledge of classic mechanics and related topics.

A TEAM OF UP TO: 2 EYE PROTECTION: B IMPOUND: Yes APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**
 - a. The event has two parts: Part 1 - written test on classic mechanics concepts, and Part 2 - vehicle testing.
 - b. For Part 2, the vehicle(s) and any material needed (except tools) to adjust the vehicle(s) (e.g., shims, masses, batteries, etc.) must be impounded prior to the start of competition.
 - c. The supervisor will provide the track(s).
 - d. For both parts, all reference materials must be secured in a 3-ring binder so that regardless of orientation, none can fall out. Calculators of any type are allowed and need not be impounded.
 - e. Competitors must wear eye protection during set-up and testing of their vehicle(s). Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. If not, teams are not allowed to compete in Part 2.
3. **CONSTRUCTION:**
 - a. Vehicles may be made of any material, but must meet all specifications and cannot modify the track.
 - b. The length of the vehicle must be between 15.0 and 30.0 cm (excluding an optional tether system, see 3.k.) and cannot vary during the run. Vehicles, excluding dowel (see 3.f), must be less than 20.0 cm tall with the propellers in motion when non-levitated.
 - c. The mass of the vehicle (including batteries and dowel) must be no more than 2000.0 grams.
 - d. It is recommended that the vehicle(s) be adjustable to accommodate variations in track width and track height.
 - e. The entire vehicle, except for the propeller and any propeller shielding (see 3.h.), must not extend outside of the vertical planes defined by the inside edge of the side rails of the track (see 4.b.).
 - f. The vehicle must have a 1/4" dowel vertically attached within 5.0 cm of its front edge such that the top end is between 30.0 and 35.0 cm above the lowest vehicle surface. The dowel must have a rigid flag (sized at least 5.0 x 5.0 cm) at top such that one of the 5 cm sides is parallel to the track and another is parallel to the dowel, with the flag pointed to the rear of the vehicle.
 - g. Commercial batteries, not exceeding 9.0 V as labeled, may be used to energize the motors on the vehicle. Multiple batteries may be connected together as long as the expected voltage across any points does not exceed 9.0 V as calculated by their labels. The vehicle must not have any other energy sources.
 - h. Vehicles must have no more than two motors each rotating one propeller. Propellers must have a diameter of ≤ 14.0 cm and must be shielded from direct contact such that the event supervisor is not able to make contact with the propeller with a standard 1/4" dowel. The supervisor must be able to verify these diameters.
 - i. Brushless motors and integrated circuits are not permitted.
 - j. The vehicle must be levitated as it moves down the track (inadvertent contact is permitted). Competitors must demonstrate levitation by pushing the vehicle slightly down. If it then rises it is levitated.
 - k. Vehicles must have an electric switch to permit safe starting. Vehicles must have an electric switch to permit safe starting. A stopping system **to either stop vehicle motion or shut off the motor is recommended. Competitors may interact with the stopping system during the run.**
4. **THE TRACK:** More information is provided on the event page on www.soinc.org
 - a. The supervisor will supply two 8' 2"x4"s (wooden or metal), 4 large "C" clamps, a cushioned barrier to stop vehicles, and a ~8' long table or countertop (minimum length 215.0 cm & width between 60.0 cm and 95.0 cm).
 - b. Each 2"x4" must be clamped to the table at both ends with the 4" side flat to the table to form the side rails of the track. There must be a gap of ~20.0 cm between the 2"x4"s to form a channel that is the track for the vehicles.
 - c. At one end of the track, a start line must be marked on the 2"x4"s that is 35.0 cm from the edge of the table.
 - d. At the other end of the track, the cushioned barrier must block the channel. It must not extend any further than 15.0 cm from the edge of the table.
 - e. Multiple tracks may be used to facilitate all teams being able to compete in a timely manner, but the

dimensions and specifications of all tracks must be the same for all teams.

5. **THE COMPETITION:**

a. **Part 1: Written Test**

- i. Unless otherwise requested, answers must be provided in metric units with appropriate significant figures.
- ii. Teams must be given a set amount of time (20 – 30 minutes is suggested) to complete a written test.
- iii. The competition must consist of at least five tasks/questions from each of the following areas:
 1. Newton's Laws of Motion
 2. Kinematics
 3. Kinetic energy
 4. Air cushioned vehicles and applications

b. **Part 2: Vehicle Testing**

- i. The length of the timed portion of the track is between 100.0 cm and 195.0 cm. Supervisors must mark the distance on the track with both start and finish lines. The target time is between 5.0 and 25.0 s. The event supervisor must announce the exact length and time after impound, which must be the same for all teams.
 - ii. Competitors must have a total of 8 minutes to orient, adjust and repair their vehicle(s), and make two successful or five failed runs. Vehicles that do not meet the construction specs must not run until brought into spec, and must be assessed the construction penalty.
 - iii. Competitors must place their vehicle on the track directly before the start line. They must place an object in front of their vehicle to keep it from moving. Prior to starting a run, and without actually turning on the motor, teams must demonstrate a safe starting and ending process.
 - iv. When ready, competitors may turn on their motors and indicate that their vehicle is ready.
 - v. Competitors must not touch their vehicle after they have turned on their motors.
 - vi. The judge must give a countdown of "3, 2, 1, launch". The competitors must then release their vehicle by removing the object and stepping away from the track. Timing must start when the dowel crosses the start line and stop when it crosses the finish line.
 - vii. Supervisors are encouraged to use photogates for more precise timing and use at least one back-up manual timer. If only manual timers are utilized, 3 timers are recommended on all runs. The middle value of the 3 timers must be the officially recorded time. Time is recorded in seconds to the precision of the device.
 - viii. Runs may be done with one vehicle or competitors may use different vehicles for each of the runs. A run must count as long as it is started before the 8-minute period elapsed.
 - ix. If a vehicle fails to move after 3 seconds, or moves only part of the way down the track, **or moves extremely slowly** competitors must be allowed to restart their vehicle without penalty up to four times within the 8-minute window or until two successful runs have been completed. Additional successful runs are not allowed.
 - x. If during a run any part of the vehicle falls off, the run must be counted as a failed run and the team will be allowed to repair and restart their vehicle or replace it with another impounded vehicle.
 - xi. Teams filing an appeal regarding Part 2 must leave their vehicle(s) and track in the competition area.
6. **SCORING:** A scoring rubric is available on the event page on www.soinc.org
- a. Mass Score (MS) = (mass of vehicle / mass of heaviest successful vehicle) x 25 points.
 - b. Teams whose vehicle(s) only move partially down the track get a MS = 0. Teams whose vehicle(s) do not move past the start line or attempt any runs get a MS = -5. Teams that fail to impound get a MS = -10.
 - c. Time Score (TS) = (1-(abs (run time – target time) / run time)) x 25 points. The smallest possible TS is 0. Teams with no successful runs receive a TS and MS of 0.
 - d. Exam Score (ES): The test used for Part 1 of this event must be worth 50 points.
 - e. Penalties: 2 points - each Competition violation; 20 points - Construction violation (only once total).
 - f. Final Score (FS) = MS + TS + ES - Penalties. The maximum possible FS is 100 points. High score wins.
 - g. Tie Breakers: 1st - Best ES; 2nd - Best MS; 3rd - Best TS; 4th - Best 2nd TS; 5th - specific test questions

Recommended Resources: All reference and training resources including the **Hovercraft DVD** and the **Chem/Phy Science CD WILL BE IN 2017** available on the Official Science Olympiad Store or Website at www.soinc.org